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MARITIMES
CANADIAN FORESTRY SERVICE

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Fredericton, New Brunswick

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ABSTRACT

Infestation of the spruce beetle have resulted in widespread mortality in the spruce forests of Nova Scotia. An estimated 18% of the merchantable white spruce volume, or 1 584 900 m^3, is dead and 9%, or 799 200 m^3, is infested with the beetle. Only 5% of the red spruce stands examined were infested with the beetle. Attack was more common in white spruce >22 cm diameter than in small trees.

RESUME

Les invasion du dendroctone de l'épinette se sont soldées par une mortalité étendue dans les forêts d'épinettes de la Nouvelle-Ecosse. Un pourcentage estimé à 18% du volume d'épinette blanche exploitable, soit 1 584 900 m^3, est mort et un autre de 9%, soit 799 200 m^3, est infesté par le dendroctone. Seulement 5% des peuplements d'épinette rouge examinés étaient infestés par le dendroctone. En général, l'épinette blanche de plus de 22 cm de diamètre était davantage attaquée que les petits arbres.

INTRODUCTION

Periodic outbreaks of the spruce beetle Dendroctonus rufipennis Kby. have resulted in substantial losses in the spruce (Picea spp.) forests of eastern Canada (Craighead 1950, Gobeil 1941, Swaine 1917). Populations of the beetle are usually maintained in logging debris such as cull logs, stumps, or slash (Dyer and Taylor 1971). When an overabundance of suitable breeding material facilitates the production of large beetle populations, particularly from widely scattered blowdown, standing live timber can be attacked (Dyer and Taylor 1971, Watson 1928, Wygant and Lejeune 1967).

In Nova Scotia, small sporadic outbreaks of the beetle occurred in mature white spruce, P. glauca (Moench.) Voss, stands on Cape Breton Island in 1952 and 1958 (Reeks et al. 1952, Forbes et al. 1958). In 1967, dead and dying white spruce and black spruce, P. mariana (Mill.) B.S.P. were noted on Cape Breton Island (Forbes et al. 1967) and by 1969 up to 57% of the white spruce examined at 26 locations were dead or dying (Forbes et al. 1969). In 1969, spruce mortality caused by the beetle was noted also on mainland Nova Scotia in Antigonish County (Forbes et al. 1969). Since then, scattered patches of dead trees have been found throughout most of the spruce forests of the Province. One particular infestation was in Victoria Park, Truro, where red spruce, (P. rubens Sarg.), and some white spruce, over 73 ha (180 acres), were killed or infested with the beetle. Within 36 ha (90 acres) of this area, 50% of the spruce was dead and 35% infested (Forbes et al. 1975). A sanitation program was initiated where infested trees and overmature spruce were removed. In many areas, spruce mortality is associated with the weakening of trees by repeated defoliation caused by the spruce budworm, Choristoneura fumiferana (Clem.) or by widespread blowdown.

In this report, the distribution of the beetle in the spruce forests of Nova Scotia and an estimate of the merchantable volume affected by the beetle are discussed, along with notes on the behaviour of the insect in infested white spruce stands.

METHODS

Detection

In 1979, a study was undertaken to determine the incidence of the spruce beetle in white and red/black spruce stands in Nova Scotia. Three hundred preselected points in the Province (Fig. 1) were examined for the presence or signs of beetle activity. The number of points per spruce species and their distribution were based on the proportion of the spruce volume occurring in each species and in each county as determined from the Nova Scotia Forest Inventory volume data. Points were located from 1:250,000 UTM grid maps on roads assumed to be passable by car and the appropriate bearing was selected. Additional points were included from preselected spruce stands examined in 1978.

At each preselected point and along the road of travel, the nearest stand of the designated spruce species containing spruce >18 cm dbh (diameter at breast height) and with at least 20% spruce content was examined. In each of three plots, the condition of spruce >18 cm dbh, the presence of old or recent blowdown and/or cutover, and the number of living or dead trees by species, were recorded. Also a prism sweep was made to determine the basal area of the stand. The first plot was established at a distance equal to the height of the stand along a preselected compass bearing. Ten spruce trees >18 cm dbh were examined and classified as:

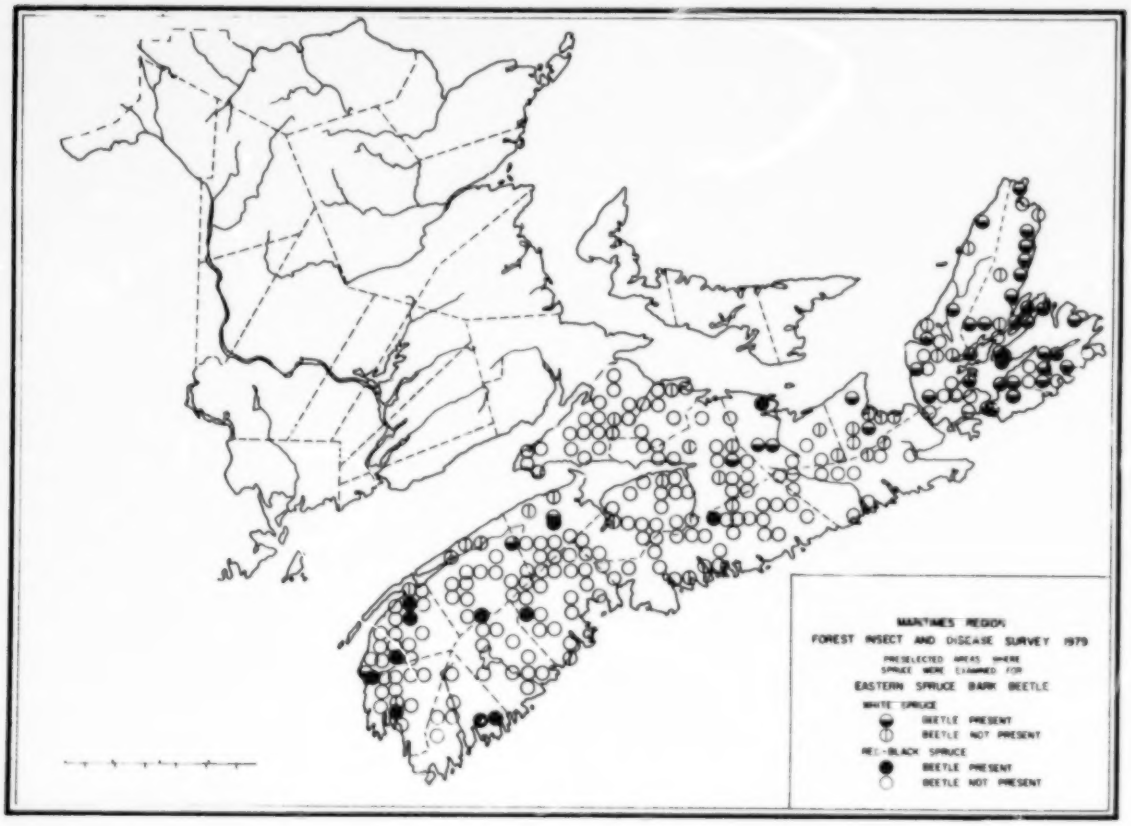

Fig. 1. Distribution of points sampled for the spruce beetle and locations where the beetle was found.

1. Healthy,
2. Living and infested with spruce beetle,
3. Dead from beetle,
4. Dead from other causes.

The second and third plots were established 30 double paces from the tenth tree examined at each of the preceding plots and along the designated compass bearing. A total of 30 spruce of the designated species was examined for the presence or signs of beetle attack. If a change of cover type, field, or clear-cut was encountered, compass bearings were altered 90 degrees to remain within the spruce stand.

Damage Appraisal

Since the 1979 detection survey indicated that the beetle was more common in white spruce stands than in stands of other spruce species, an attempt was made to assess the impact of the beetle on the white spruce inventory. To estimate damage within ±15-20% standard error, 17-31 infested white spruce stands were needed. Twenty-four stands were sampled in the fall of 1979 and early spring of 1980 to determine the volume of white spruce affected by the spruce beetle. The distribution of these stands was based on the proportion of merchantable white spruce volume in each

subdivision, as designated by the Nova Scotia Forest Inventory (Fig. 2). Most of these stands were in the infested areas located during the detection survey; others were sampled in some subdivisions according to the distribution of white spruce.

At each location, the stand was entered a distance equal to its height. At the first infested tree located, a prism point was established. All trees that fell within each prism point were tallied as to species, dbh, living or dead, and each spruce was classified as follows:

1. Healthy
2. Living and infested (pitch tubes or pitch streaks usually present)
3. Recently dead from beetle (discolored foliage present but cambium dead)
4. Dead from beetle (no foliage remaining, cambium dead, loose bark in patches, insect galleries in bark)
5. Dead from other causes

Two additional points were established at 50-m intervals along the compass bearing used in the detection tally. Where necessary, bearings were altered to remain within the spruce stand but not to get more infested trees in the tally.

RESULTS AND DISCUSSION

Detection and Damage Appraisal

A total of 327 stands in Nova Scotia was examined for the presence of the spruce beetle, 83 white spruce and 244 red/black (Table 1). Based on figures from the Nova Scotia Forest Inventory, white spruce represents 22% of the total merchantable spruce volume and red/black spruce, 78%. Because of widespread hybridization between red spruce and black spruce, identification of individual trees is difficult as many of the characteristics are intermediate (Manley 1971), therefore red and black spruce are grouped together in forest inventory volumes.

Forty-eight percent (range 0-73%) of the white spruce stands examined were infested with or damaged by the beetle. Negative results at any given location indicated only that the trees examined at that point were not infested but did not preclude the presence of beetles in the area. Based on the detection survey, an estimated 8 116 000 m^3, 39% of the total merchantable white spruce volume, are infested with the spruce beetle in Nova Scotia. Eighty percent of the infested stands were in the Cape Breton Subdivision where 35% of the total merchantable white spruce volume of Nova Scotia grows. On Cape Breton Island, 73% of the stands and an estimated 5 418 000 m^3 are infested with the beetle. The Eastern Subdivision had the second greatest estimate of volume of white spruce infested with the beetle, 29% of stands infested representing 1 367 000 m^3 of merchantable white spruce (Table 1).

Only 5% (0-17%) of the red/black spruce stands examined were infested with the beetle. More than half the infested stands were found in the Western Subdivision where an estimated 17% of the total red/black spruce volume is infested. Only 5% of the total merchantable red/black spruce volume (3 568 000 m^3) in the Province is estimated to be affected by the spruce beetle (Table 1).

The beetle was more common in white spruce (48% of stands infested) than in red/black (5% of the stands infested). Examination of white spruce in 24 infested stands showed that 27% of the merchantable white spruce volume or 2 384 100 m^3 are affected by the beetle, 18% of which is dead and 9% infested (Table 2). The greatest volume affected is on Cape Breton Island where 30% of the estimated merchantable volume attacked, or 1 630 800 m^3, is either dead

Table 1. Detection of spruce beetle in white spruce (wS) and red/black spruce (rS and bS) stands in Nova Scotia with an estimate of the volume infested according to Inventory Subdivision, 1979

Inventory Subdivision	Total volume[a] spruce wS	Total volume[a] spruce rS & bS	No. stands examined wS	No. stands examined rS & bS	No. and % of stands with spruce beetle wS	No. and % of stands with spruce beetle rS & bS	Estimated infested volume wS	Estimated infested volume rS & bS
Cape Breton	7422	6291	44	26	32(73)	1(4)	5418	252
Eastern	4713	7235	14	18	4(29)	1(6)	1367	434
North Central	3200	16500	8	50	1(12)	0(0)	384	0
South Central	1354	21026	4	55	0(0)	1(2)	0	421
Southshore	433	7859	1	28	0(0)	1(4)	0	314
Valley	2997	7096	9	27	2(22)	2(7)	659	497
Western	872	9704	3	40	1(33)	7(17)	288	1650
Total	20991	75711	83	244	40(48)	13(5)	8116	3568

[a] All volumes in thousands cubic metres.

Table 2. Damage to white spruce stands in Inventory Subdivisions of Nova Scotia caused by the spruce beetle, fall 1979 - spring 1980.

Inventory Subdivision	Estimated volume[a] wS affected by spruce beetle	% of Volume Infested	% of Volume Dead	No. of plots	Volume Infested	Volume Dead	Total
Cape Breton	5418	10.0	20.1	12	541.8	1089.0	1630.8
Eastern	1367	11.1	11.0	3	151.7	150.4	302.1
North Central	384	22.7	52.1	2	87.2	200.1	287.3
South Central	271[b]	0	21.2	2	0	57.5	57.5
Southshore	216[c]	0	15.5	1	0	33.5	33.5
Valley	659	2.8	2.7	3	18.5	17.8	36.3
Western	288	0	12.7	1	0	36.6	36.6
Total	8603			24	799.2	1584.9	2384.1

[a] All volumes in thousands cubic metres.
[b] Estimated at 20%.
[c] Estimated at 50%.

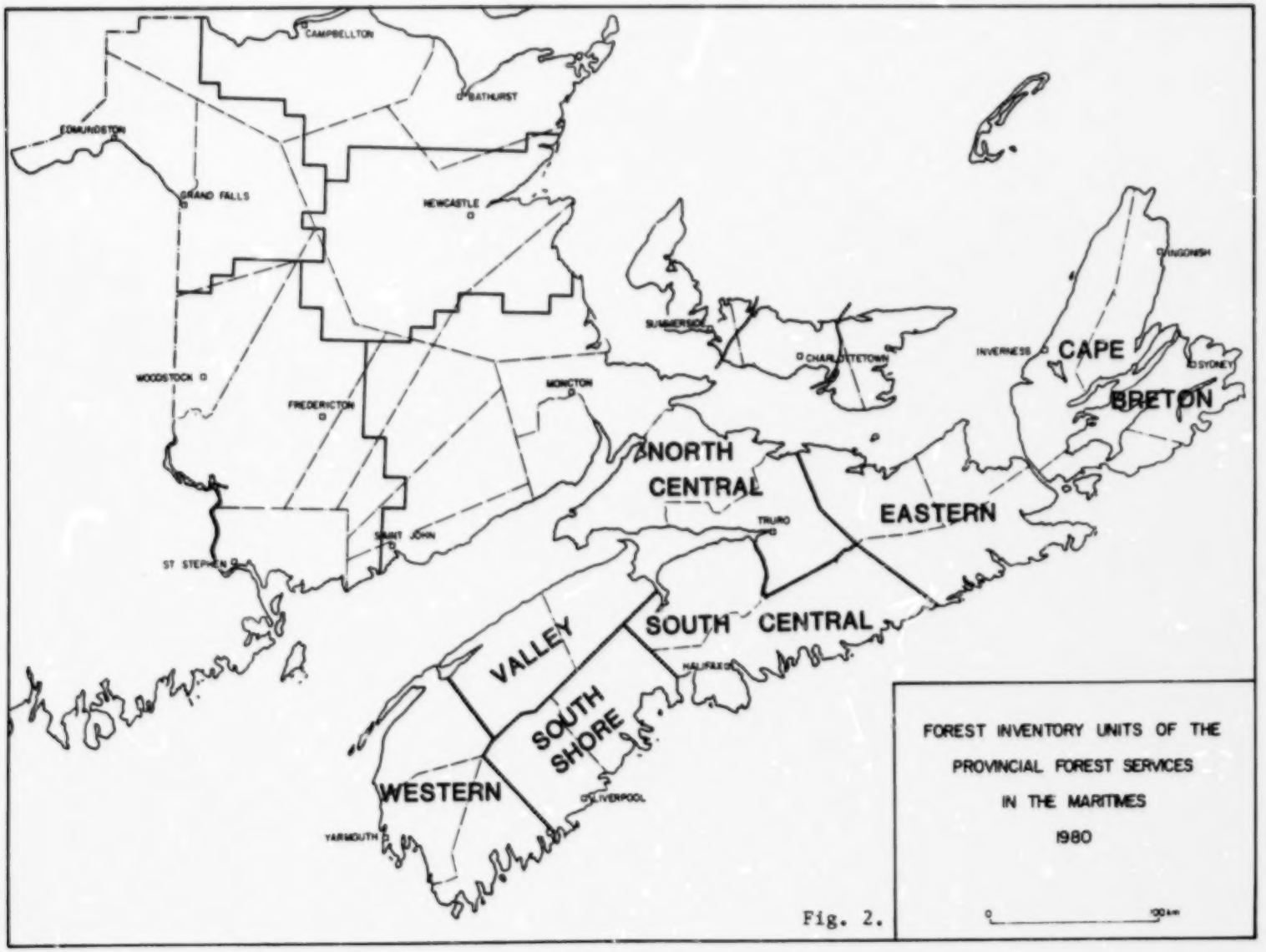
CAMPBELLTON
BATHURST
EDMUNDSTON
GRAND FALLS
NEWCASTLE
WOODSTOCK
FREDERICTON
MONCTON
SUMMERSIDE
CHARLOTTETOWN
INVERNESS
CAPE
BRETON
SYDNEY
NORTH
CENTRAL
EASTERN
TRURO
SAINT JOHN
ST STEPHEN
VALLEY
SOUTH CENTRAL
SOUTH
SHORE
HALIFAX
WESTERN
LIVERPOOL
YARMOUTH
FOREST INVENTORY UNITS OF THE
PROVINCIAL FOREST SERVICES
IN THE MARITIMES
1980
0
100 km

Fig. 2.

(20%) or infested (10%) by the beetle. Sixty-eight percent of the total volume of white spruce infested or dead from the beetle is in Cape Breton (Table 2).

White spruce volume infested with the spruce beetle was estimated for the South Central and Southshore Subdivisions. Examination of preselected points in the detection survey revealed no infestations, however, infested stands were located for damage assessment. Assuming the next stand in each of these two subdivisions to be infested with the spruce beetle, the maximum percentage of infested stands would be 20% for the South Central (4 stands examined and no beetles found) and 50% for Southshore subdivisions (one stand examined, no beetles found).

Beetle Attack

Watson (1928) found the spruce beetle breeding exclusively in white spruce and considered black spruce totally immune from the beetle even when trees were of moderate size (ca. 30 cm). In Nova Scotia, the beetle was found more commonly in white spruce, however, both red spruce and black spruce were infested. Attack on white spruce was readily visible, usually as reddish-brown pitch tubes. Pitch tubes were absent on red or black spruce and attack could only be confirmed by peeling the bark scales and searching for the beetle or its galleries in the cambium tissue.

Examination of 857 white spruce in 24 infested stands showed that 73.2% of the white spruce were healthy, 22.5% infested or dead from beetle damage, and 4.3% dead from other causes. As reported by Schmid and Frye (1977) the beetle showed a preference for larger diameter white spruce (Fig. 3). The smallest tree attacked was 12 cm dbh, the largest being 66 cm dbh (avg. 30 cm dbh). About 34 m^3/ha or 27% of the merchantable white spruce on the infested stands was affected by the beetle (Table 3). Trees in the >22 cm diameter class suffered the greatest frequency of attack with 82% of the merchantable volume infested with or dead from the beetle.

SUMMARY

The spruce beetle was found in 48% of the white spruce stands and 5% of the red/black spruce stands examined in Nova Scotia during 1979. An estimated 8 116 000 m^3 of white spruce and 3 568 000 m^3 red/black spruce are infested with the beetle. Examination of infested stands indicated that 18% of the merchantable volume of white spruce (1 584 900 m^3) is dead and 9% (799 200 m^3) is infested with the beetle. The beetle tended to attack larger diameter white spruce (avg. 30 cm dbh). Without suitable control strategies populations of the spruce beetle will continue to increase, resulting in greater losses of merchantable volume of spruce.

Table 3. Average volume (m^3) per hectare of white spruce examined in 24 stands infested with the spruce beetle in Nova Scotia, fall 1979-spring 1980

Condition of white spruce	Merchantable volume (m^3/ha) Diameter Class (cm) 10-14	16-20	≥22	Total
Healthy	15.0	31.2	39.2	85.4
Infested or dead from spruce beetle	1.1	4.9	27.7	33.7
Dead from other causes	1.7	1.2	1.7	4.6
Total	17.8	37.3	68.6	123.7

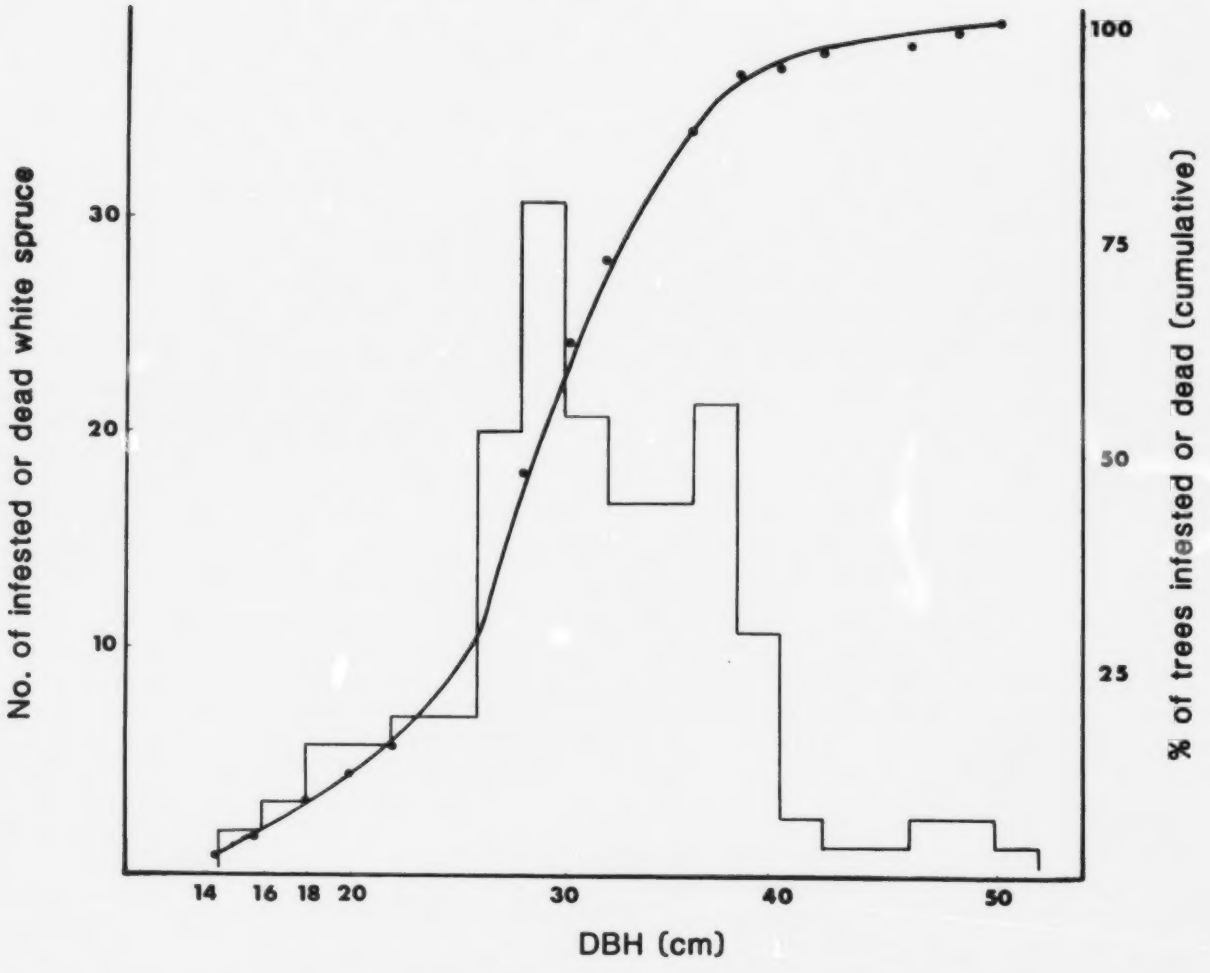

Fig. 3. Relationship of infestation by the spruce beetle to diameter at breast height of white spruce.

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